BAYOU LAFOURCHE TMDLS FOR DISSOLVED OXYGEN AND NUTRIENTS

May 28, 2002

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FOR DISSOLVED OXYGEN AND NUTRIENTS

SUBSEGMENT 080904

Prepared for

US EPA Region 6
Water Quality Protection Division
Watershed Management Section

Contract No. 68-C-99-249
Work Assignment #2-108

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May 28, 2002

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources (NPS) discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) and nutrients for Bayou Lafourche (subsegment 080904), in the Ouachita River basin in northern Louisiana.

Bayou Lafourche subsegment 080904 extends approximately 72 km upstream from its confluence with Big Creek near Ft. Necessity, LA. Tributaries to Bayou Lafourche are included in subsegment 080904 except for Stalkinghead Creek and Wham Brake, which are separate subsegments. Subsegment 080904 covers approximately 473 mi^2 and is 60% agricultural. Flows in Bayou Lafourche are partially controlled by the dam at Irwin Lake. Bayou Lafourche is used as a diversion canal for a portion of Boeuf River flows.

Subsegment 080904 was listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #2 for TMDL development. The causes for impairment cited in the 303(d) List included nutrients. The water quality standard for DO in this subsegment is 5 mg/L year round.

A water quality model (LA-QUAL) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in the subsegment. The model was set up and calibrated using LDEQ intensive survey data collected during 1999, observations from a synoptic survey conducted by FTN Associates, Ltd. (FTN) during August 2001, and other various information obtained from LDEQ and US Geological Survey (USGS). The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing NPS loads and modification of point source release water quality were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

A TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) was calculated using the results of the projection simulation. Both implicit and explicit margins of safety were included in the TMDL calculations. The nutrient TMDL was developed based on Louisiana's water quality standard for nutrients, which states that "the naturally occurring range of nitrogen to phosphorus ratios shall be maintained". The nutrient TMDL was calculated using allowable nitrogen loading from the projection simulation and applying a naturally occurring nitrogen to phosphorus ratio to determine the allowable phosphorus loading.

Twenty-four point sources were identified in subsegment 080904. Therefore, each TMDL for this subsegment includes wasteload allocations (WLAs) for the point sources, and load allocations (LAs) for the nonpoint sources. In order to maintain the DO standard of 5.0 mg/L throughout the subsegment, nonpoint source loads will need to be reduced 81%, and treatment upgrades will be required for some of the point sources. Releases from upgraded point sources will need to meet the following water quality limits; 5.0 mg/L for DO, 10 mg/L for BOD_5, 2 mg/L for ammonia nitrogen, and 1.0 mg/L for organic nitrogen.

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1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO) and nutrients for the lower Bayou Lafourche, which is subsegment 080904. This subsegment was listed on the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000) as not fully supporting the designated use of propagation of fish and wildlife. The suspected sources and suspected causes for impairment in the 303(d) List are included in Table 1.1. Subsegment 080904 was ranked as priority #2 for TMDL development. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7. The 303(d) Listings for other pollutants in this subsegment are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

Table 1.1. Summary of 303(d) Listing of subsegment 080904 (EPA 2000).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
080904	Bayou Lafourche	Minor industrial point sources Major industrial point sources Pastureland Unknown Source	Organic Enrichment/low DO Suspended solids Turbidity Pesticides Nutrients Mercury Priority Organics Pathogen Indicators	2

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Bayou Lafourche (subsegment 080904) is located approximately 5 miles east of Monroe, LA in the Ouachita River basin (see Figure A.1 in Appendix A). The subsegment area is 473 mi^2. The majority of the landuse in the subsegment is agricultural. Land use data for the study area is shown in Table 2.1.

The Bayou Lafourche subsegment 080904 extends approximately 72 km upstream from its confluence with Big Creek near Ft. Necessity, LA. Tributaries to Bayou Lafourche are included in the subsegment except for Wham Brake, which is a separate subsegment. Flows in Bayou Lafourche are partially controlled by the dam at Irwin Lake. Bayou Lafourche is used as a diversion canal for a portion of Boeuf River flows. Water from Boeuf River is diverted into Bayou Lafourche east of Oak Ridge, LA, upstream of subsegment 080904. Bayou Bonne Idee also joins Bayou Lafourche upstream of the segment. Flows into Bayou Lafourche from Wham Brake are controlled. Typically there are no releases from Wham Brake to Bayou Lafourche during the summer.

Table 2.1. Land uses in subsegment 080904 based on GAP data (USGS 1998).

Land Use Type	% of Total Area
Fresh Marsh	0.3%
Saline Marsh	0.0%
Wetland Forest	21.2%
Upland Forest	9.5%
Wetland Scrub/Shrub	1.0%
Upland Scrub/Shrub	0.4%
Agricultural	60.0%
Urban	1.6%
Water	5.9%
Barren Land	0.1%
TOTAL	100.0%

2.2 Water Quality Standards

The numeric water quality standards and designated uses for this subsegment are shown in Table 2.2. The primary numeric standard for the TMDLs presented in this report is the DO standard of 5 mg/L year round.

Table 2.2. Water quality standards and designated uses (LDEQ 2000).

Subsegment Number	080904
Waterbody Description	Bayou Lafourche - near Oak Ridge to Boeuf River near Columbia
Designated Uses	ABC
Criteria:	
Chloride	500 mg/L
Sulfate	200 mg/L
DO	5 mg/L (year round)
pH	6.0-8.5
Temperature	32 °C
TDS	1500 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

For nutrients, there are no specific numeric criteria, but there is a narrative standard that states “The naturally occurring range of nitrogen-phosphorus ratios shall be maintained.... Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.” (LDEQ 2000).

In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated, “That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts.” DO serves as the indicator for the water quality criteria and for assessment of use support. For the TMDLs in this report, the nutrient loading required to maintain the DO standard is the nutrient TMDL.

2.3 Identification of Sources

2.3.1 Point Sources

A listing of all NPDES permits in the Ouachita and Calcasieu River basins was searched to identify any permits within the Bayou Lafourche subsegment (080904). This listing was prepared by EPA Region 6 using databases and permit files from LDEQ. Based on this listing, 24 NPDES permits were identified within subsegment 080904 (Appendix B). Of the 24 point sources 4 were large enough to be included in the model while the other 16 were included in the TMDL calculations for this subsegment. Table 2.3 is a summary of the permit information for the point sources included in the model.

Table 2.3. Summary of NPDES permit information for modeled point sources.

Permit No.	Facility Name	Receiving Water	Design Flow	Permitted Parameters	Permit Limits (mg/L)
LA0104264	Tidwell	Bayou Mouchoir des L'ourse	0.4	BOD_5	10
LA0101834	Greater Ouachita County SE Regional WWTF	Bayou Mouchoir des L'ourse	0.52	CBOD TSS	10 15
LA005501	Sunshine Oil & Storage	Prairie Bayou	0.28	BOD_5 TSS	45 90
LA0108081	Bayou Utilities	Racoon Bayou	0.09	BOD_5 TSS	10 15

2.3.2 Nonpoint Sources

The NPS in the Bayou Lafourche subsegment (080904) cited as the suspected source of impairment in the 303(d) List (Table 1.1) was pastureland.

2.4 Previous Data and Studies

Listed below are previous collected water quality data and studies in or near the Bayou Lafourche subsegment. The locations of the LDEQ ambient monitoring stations are shown on Figure A.2 (in Appendix A).

1. Monthly data collected by LDEQ for "Bayou Bonne Idee Northeast of Oak Grove, LA, Louisiana" (Station 0122) from February 1982 to December of 1999.

2. Monthly data collected by LDEQ for "Bayou Lafourche Canal Near Columbia, Louisiana" (Station 0071) from March of 1978 to December 1999.

3. Monthly data collected by LDEQ for "Bayou Lafourche Near Crew Lake, LA" (station 0124) from 1982 to 1998.

4. Stream Discharge Forms from LDEQ Intensive Survey 1999.

   12/06/1999-4 sites, starting at Boscoe Lane Bridge (max distance 208 ft) to 15 yds upstream of Ruby Road bridge (max distance 32 ft).

   10/5,6/99-5 sites, starting at Boscoe Rd Bridge (max distance 205 ft) to 15 yards upstream of Ruby Road bridge (max distance 9.3 ft)

   8/16/99- 6 sites, starting 1 mile North of Lafourche (max distance 40.5) and ending at Ruby rd Bridge (max distance 20.6 ft).

   01/11/99- Bosco Lane Bridge (max distance 210 ft)

   01/11/00- 3 sites Railroad bridge (max distance 97 ft), ¼ mile downstream from dam (max distance 99 ft), and Ruby Road bridge (max distance 30 ft).

5. Bayou Lafourche Survey Field Notes (8/16/99)
   This survey had 17 sites going from Bayou Lafourche cut off to Little Lake. Several parameters were measured, such as pH, DO, temperature, Doc, conductivity, chlorophyll, and pHmv. The weather conditions were also noted and as well a the stream cross section at 6 sites.

6. Stream Survey/International Paper Reports
   Jan, Feb, March, July , Aug, Sept, Oct 1981, Feb March April May June July, Sept, Aug, Nov Dec 1982. These reports have several sites starting with the paper mill discharge point to a final site at highway 15 (41 miles downstream). Temperature, alkalinity, BOSs and suspended solids are recorded.

7. "Draft Dioxin TMDL for Wham Brake and Bayou Lafourche. Subsegments 080900 and 080904." Parsons, 2002.

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 4.13), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBODu), and DO.

Figure A.3 in Appendix A shows the model reach/element design and the location of the modeled inflows. Bayou Lafourche was divided into 5 reaches to represent varying depths and widths along the stream. Little Bayou Boeuf below Wham Brake, and Petticoat Bayou with Bayou Mouchoir de L'ourse were modeled as branches to the system. The Little Bayou Boeuf branch was modeled as one reach. The Petticoat Bayou-Bayou Mouchoir de L'ourse branch consisted of two reaches, one reach for each bayou. All reaches were divided into smaller elements to take into account variation in water quality along their length.

3.2 Calibration Period and Calibration Targets

An intensive field survey was conducted on Bayou Lafourche by LDEQ in 1999. In addition, routine water quality monitoring has been conducted at two LDEQ sampling stations: station 0071 Bayou Lafourche canal near Columbia (since 1978), and station 0124 Bayou Lafourche Canal near Crew Lake (since 1982). A synoptic survey of the subsegment was performed by FTN in August 2001. The water quality data collected by both LDEQ and FTN are compiled in Appendix C.

The two conditions that usually characterize critical periods for DO are high temperatures and low flows. High temperatures decrease DO saturation values and increase rates for oxygen demanding processes (BOD decay, nitrification, and sediment oxygen demand (SOD)). In most systems, low flows cause reaeration rates to be lower. The purpose of selecting a critical period for calibration is so that the model will be calibrated as accurately as possible for making projection simulations for critical conditions.

Based on the data in Appendix C, the calibration period was selected as July 14 to August 12, 1986. This period represented the most critical period for DO. The calibration target (i.e., the concentration to which the model was calibrated) for each parameter was set to the average of the concentrations measured during the calibration period. The LDEQ routine monitoring data did not include carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, or organic nitrogen, but there were measurements of total organic carbon (TOC) and TKN. Therefore, the calibration target for CBODu was estimated from the TOC data based on statistics from LDEQ's long term BOD analyses. The LDEQ's long term BOD analyses consisted of 140 samples from intensive surveys in the Ouachita River basin during 2001. These samples were analyzed for numerous parameters including CBODu and TOC. The ratio of CBODu to TOC was calculated for each sample and the median of these 140 ratios was determined to be 1.10. Using this result, the CBODu calibration target was estimated as 1.10 times the average TOC during the calibration period. Data from the LDEQ long term BOD analyses are shown in Appendix D.

Ammonia nitrogen and organic nitrogen were estimated from TKN. Monthly TKN and ammonia nitrogen data were available at LDEQ station 0071 (Bayou Lafourche Canal near Columbia) for 1999. The average ratio of ammonia nitrogen to TKN was calculated for this data. Ammonia nitrogen for the calibration targets was then estimated as the average TKN multiplied by this ratio. Organic nitrogen was estimated as TKN minus the estimated ammonia nitrogen value.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the "LTP"; LDEQ 2001). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (value in LTP is same as model default)

- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.020 (not specified in LTP; model default used)
- Correction for reaeration: automatically calculated by the model

3.4 Hydraulics (Data Type 9)

The hydraulics were specified in the input for the LA-QUAL model using the power functions (width = a * Q^b + c and depth = d * Q^e + f). The typical width and depth of the reaches of the Lafourche branch were based on cross section data collected by LDEQ during their intensive survey. Typical widths for the tributary reaches (Little Bayou Boeuf and Petticoat Bayou) were taken from DOQQs. Typical tributary depths were estimated from the widths using the width to depth ratio for Young's Bayou. The ratio was calculated from cross sections measured by LDEQ during the 1999 intensive survey. Plots of the typical width and depth for each reach along with the measured data are included in Appendix E.

Width and depth were assumed to vary with flow in all reaches except Reach 1. Reach 1 is an impoundment (Irwin Lake) so we assumed its width and depth would remain fairly constant. During the 1999 intensive survey, LDEQ collected a series of cross section measurements with flows at 4 stations on Bayou Lafourche (stations 3,4, 5, and 6) and one station on Young's Bayou (station 10, see Figure A2). These data did show that width and depth vary with flow. Power functions were fit to these data (Appendix E). Data for stations 3 and 4 were combined because their relationships appeared to be very similar. The exponents for these functions were used in the model for the width and depth exponents (b and e). The sum of the width and depth exponents from the power functions fit to the Young's Bayou data was greater than 1.0, probably as a result of backwater conditions during high flows. Therefore, the average of the width and depth exponents from the Bayou Lafourche stations were used as the width and depth exponents for the tributary reaches. The width and depth coefficients for each reach were calculated using flows measured during the LDEQ intensive survey and the typical reach widths and depths. These calculations are included in Appendix E. Values used in the model are shown in Appendix F.

3.5 Initial Conditions (Data Type 11)

Because temperature is not being simulated in the model, the temperature for the reach was specified in the initial conditions for LA-QUAL. The temperature for the reach was set to 28.6°C, which was the average of temperatures measured at LDEQ stations 0071 and 0124 during the calibration period. The input data and sources are shown in Appendix F.

For constituents not being simulated, the initial concentrations were set to zero. Otherwise the model would have assumed a fixed concentration of those constituents and the model would have included effects of the unmodeled constituents on the modeled constituents.

3.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, CBOD decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix F.

For reaeration, the Louisiana Equation (option 15) was specified in the model because it was developed specifically for streams in Louisiana and it has been used successfully in the past for other TMDLs in Louisiana.

The rates for CBOD decay and nitrification (ammonia nitrogen “decay”) were based on median values of laboratory decay rates from LDEQ’s long term BOD analyses. The LDEQ long term BOD analyses consisted of 140 samples from intensive surveys in the Ouachita River basin during 2001. The median decay rates for CBOD and nitrogenous biochemical oxygen demand (NBOD) were approximately 0.06/day and 0.07/day, respectively. These data are shown in Appendix D. Because instream decay rates are typically slightly higher than laboratory decay rates, both the CBOD decay rates and the nitrification rates were set to 0.10/day for all reaches.

The mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was similar to the values shown in Table 5.3 of the “Rates, Constants, and Kinetics” publication (EPA 1985) for dissolved organic nitrogen being transformed to ammonia nitrogen. The literature values for mineralization rates are shown in Appendix G.

One other input value was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO. Option number 1 provides nitrification inhibition that is similar to what is used in other water quality models such as QUAL2E and WASP (see Figure 3.5 in FTN 2000).

3.7 Nonpoint Source Loads (Data Type 19)

The NPS loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBOD loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix F.

Typically, these four calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables will affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBODu loads were adjusted until the predicted CBODu concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted DO concentrations were similar to the observed concentrations. The SOD rate was not adjusted below 0.5 g/m^2/day. The DO was calibrated last because all of the other state variables affect DO.

3.8 Headwater Flow and Tributary Rates (Data Types 20 and 24)

Headwater inflow rates were specified for the three branches of the model. The inflow rate for Bayou Mouchoir des L'ourse was estimated by multiplying the estimated headwater drainage area (1 mi^2) by a flow per unit area for the basin. The inflow rate for Little Bayou Boeuf was estimated from DMR flow data. The inflow rate for Bayou Lafourche was estimated by subtracting inflows for Little Bayou Boeuf and Bayou Galion from the average flow for bayou Lafourche near Crew Lake, LA (USGS 07369000).

The basin flow per unit area was calculated from flows measured at USGS stations 07369000-Bayou Lafourche near Crew Lake, LA and 07368000-Boeuf River at Girard, LA. The flow per square mile was estimated by dividing the sum of the average flows for the two stations by the sum of the reported drainage areas for the stations. These calculations are included in Appendix H.

Flow data for the control structure on Little Bayou Boeuf just below Wham Brake was available on DMRs for the period from 1993 through 2001. No flow data was available for the calibration period in 1986. To determine if one of the available years might be hydraulically similar to 1986, the average flows at USGS station 07369000 for the period from July 14 through August 12 for the years 1993 through 2001 were compared to the average flow for July 14 through August 12, 1986. The average flow for July 14 through August 12, 1999 was most similar to the average flow for the 1986 period (104 cfs and 76 cfs, respectively). Therefore, the average of flows reported on the July and August 1999 DMRs (13.5 MGD) was used for the Little Bayou Boeuf headwater flow. These calculations are also included in Appendix H.

Inflows were also estimated for Bayou Galion, Young's Bayou, Bayou Racoon, and Prairie Bayou. These inflows were estimated by multiplying the basin flow per unit area by the drainage areas for the streams. The stream drainage areas were taken from 'Drainage Areas of Louisiana Streams' (USGS 1971). These calculations are included in Appendix H. Values used in the model are shown in Appendix F.

3.9 Headwater and Tributary Water Quality (Data Types 20, 24, and 25)

Concentrations of DO, CBODu, organic nitrogen, and ammonia nitrogen were specified in the model for the headwater and tributary inflows. Water quality for the Bayou Lafourche headwater was set to the average concentrations for the calibration period at LDEQ station 0017 Boeuf River west of Oak Grove, LA. Bayou Lafourche joins Boeuf River just upstream of subsegment 080904. Water quality for Bayou Galion tributary inflow was set to the average concentrations for the calibration period at LDEQ station 0128 Galion Canal southwest of Oak Ridge, LA. This water quality data was also used for the headwater inflows of Bayou Mouchoir des L'ourse and Little Bayou Boeuf, and the tributary inflows of Young's Bayou, Racoon Bayou, and Prairie Bayou. DMR data for the Wham Brake outlet to Little Bayou Boeuf was not available for the calibration period (1986). In the course of calibrating the model, Bayou Lafourche and Little Bayou Boeuf organic nitrogen were changed to the calibration target for LDEQ station 0071. The values used as model input are shown in Appendix F.

The LDEQ monitoring data included DO, total Kjeldahl nitrogen (TKN), nitrate+nitrite nitrogen, and total organic carbon (TOC). CBODu was estimated from TOC using the relationship between these parameters that was developed from the long term BOD analyses (shown in Appendix C). The relationship is as follows:

$$CBODu = 3.94 * CBOD_5$$

$$CBODu = 1.10 * TOC$$

Ammonia nitrogen and organic nitrogen were estimated from TKN. Monthly TKN and ammonia nitrogen data were available at LDEQ station 0071 (Bayou Lafourche Canal near Columbia) for 1999. The average ratio of ammonia nitrogen to TKN was calculated for this data (Appendix I). Ammonia nitrogen for the calibration inputs was then estimated as the average TKN multiplied by this ratio. Organic nitrogen was estimated as TKN minus the estimated ammonia nitrogen value. The values used as model input are shown in Appendix F.

3.10 Point Source Inputs (Data Types 24 and 25)

Four NPDES permitted dischargers in the Petticoat Bayou basin were included in the model. The point source flows were set to their permit design flows. The point source water quality were set based on their water quality permit limits. All of the point sources have permit limits for BOD_5 or CBOD (Table 2.3). These BOD_5 and CBOD permit limits were converted to BODu by multiplying by the BOD_5:BODu ratio from the LTP (2.3). Values for DO and ammonia nitrogen were set based on the BOD_5 permit limit according to guidance in the LTP (LDEQ

2001). Organic nitrogen was set to half the ammonia nitrogen value, and nitrite+nitrate nitrogen was set to 10 mg/L. The values used as model input are shown in Appendix F.

3.11 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix J and a printout of the LA-QUAL output file is included as Appendix K. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for Louisiana waterbodies in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are; of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from perennial tributaries, point sources, SOD, and resuspension of sediments.

In reality, the highest temperatures occur in July-August and the lowest stream flows occur in October-November. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, explicit MOS of 10% for NPS, and 20% for point sources were incorporated into the TMDLs in this report to account for model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2001) specified that the critical temperature should be determined by calculating the 90^{th} percentile seasonal temperature for the waterbody being modeled. There are two LDEQ stations on Bayou Lafourche, with long term temperature records (0071 and 0124). 90^{th} percentile summer temperatures were determined for both stations. The temperature for the projection model was set to the average of these two 90^{th} percentile temperatures (29.7EC). This value was specified in Data Type 11 in the model and is shown in Appendix L. The values used to calculate the 90^{th} percentile temperature are shown in Appendix M.

Because Bayou Lafourche has a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater and Tributary Inputs

The inputs for the headwaters and tributaries for the projection simulation were based on guidance in the LTP. As specified in the LTP, the DO concentrations for the headwater inflows were set to 90% saturation at the critical temperature. Headwater concentrations for other parameters were set to calibration values. Headwater flows were set to either the 7Q10 flow or 0.1 cfs, whichever was greater.

7Q10 flows were estimated for the headwaters and tributaries. A basin 7Q10 flow per square mile was used to estimate most of the 7Q10 inflows. The basin 7Q10 flow per square mile was estimated as the sum of the reported 7Q10 flows for the USGS gages at Bayou Lafourche near Crew Lake, LA (07369000) and on Boeuf River near Girard, LA (07368000) (Appendix N), divided by the sum of their drainage areas. The 7Q10 flow for Bayou Lafourche near Crew Lake was 3.4 cfs (0.1 m^3/sec), and the 7Q10 flow for Boeuf River near Girard was 3.5 cfs (0.1 m^3/sec). Therefore, the basin 7Q10 flow was 6.9 cfs (0.2 m^3/sec) and the basin 7Q10 flow per square mile was 0.012 cfs/sq mi. This value was used to estimate 7Q10 inflows for Bayou Galion, Bayou Mouchoir des L'ourse headwater, Racoon Bayou, Prairie Bayou, and Young's Bayou. The estimated 7Q10 flows for the Bayou Mouchoir des L'ourse headwater, Racoon Bayou, and Prairie Bayou were less than 0.1 cfs. Therefore, in the projection model the flows for Bayou Mouchoir des L'ourse headwater, Raccoon Bayou, and Prairie Bayou were set to 0.1 cfs (0.028 m^3/s). Inflows for Bayou Galion and Young's Bayou were set to their estimated 7Q10 flows.

Different methods were used to determine 7Q10 inflows for Little Bayou Boeuf and Bayou Lafourche headwaters. Little Bayou Boeuf receives controlled releases from Wham Brake. During the summer there is often not enough water in Wham Brake to allow a release (Bob Jacobsen, URS Corps, personal communication 2001). Therefore, we assumed that the 7Q10 for Little Bayou Boeuf headwaters was 0 cfs. Based on the LTP guidelines then, the Little Bayou Boeuf headwater inflow was modeled at 0.1 cfs in the projection. The Bayou Lafourche headwater 7Q10 flow was estimated as the 7Q10 flow reported for the USGS gage on Bayou Lafourche near Crew Lake (4.3 cfs) minus the estimated 7Q10 flow for Bayou Galion and the 0.1 cfs flow for Little Bayou Boeuf. These calculations are included in Appendix N. The values used as model input in the projection simulation are shown in Appendix L.

4.4 Point Source Inputs

Initially, the only change made to the point source inputs from the calibration was to increase the flows. The point source flows for the projection simulation were set to 1.25 times the design flows to allow for an MOS.

During the projection simulation it became apparent that it would be necessary to adjust the point source loadings to meet the 5.0 mg/L DO standard on Petticoat Bayou. The parameter concentrations necessary to meet the DO limit for all 4 point sources were 6.0 mg/L DO, 10 mg/L BOD_5, 5 mg/L ammonia nitrogen, and 2.5 mg/L organic nitrogen (Appendix L).

4.5 Nonpoint Source Loads

Because the initial projection simulation was showing low DO values, the NPS loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. The same percent reduction was applied to the SOD and NPS mass loads of CBODu and organic nitrogen. SOD was not reduced below 0.5 g/m^2/day. The values used as model input in the projection simulation are shown in Appendix L.

4.6 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 through 4.5. Other model inputs (e.g., hydraulic coefficients, decay rates, reaeration equations, etc.) were unchanged from the calibration simulation.

4.7 Model Results for Projection

Plots of predicted water quality for the projection are presented in Appendix O and a printout of the LA-QUAL output file is included as Appendix P.

Oxygen demanding load reductions were required to meet the DO standard. An NPS load reduction of approximately 81% was required to bring the predicted DO values to at least 5.0 mg/L. This percentage reduction for NPS loads represents a percentage of the entire NPS loading, not a percentage of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for the study area. In addition to the NPS load reduction, the point sources included in the model required treatment upgrades. Revised point source limits were 5.0 mg/L for DO, 10.0 mg/L for BOD_5, 5.0 mg/L for ammonia nitrogen, and 2.5 mg/L for organic nitrogen.

5.0 TMDL CALCULATIONS

5.1 DO TMDL

A total maximum daily load (TMDL) for DO has been calculated for the Bayou Lafourche subsegment based on the results of the projection simulation. The DO TMDL is presented as oxygen demand from CBODu, organic nitrogen, ammonia nitrogen, and SOD. A summary of the loads for Bayou Lafourche is presented in Table 5.1.

The TMDL calculations were performed using a FORTRAN program that was written by FTN personnel. This program reads two files; one is the LA-QUAL output file from the projection simulation and the other is a small file with miscellaneous information needed for the TMDL calculations (shown in Appendix Q). The output from the program is shown in Appendix R and the source code for the program is shown in Appendix S.

Table 5.1. DO TMDL for Subsegment 080904 (Bayou Lafourche).

	Oxygen Demand Loads				Total Oxygen Demand (kg/day)
	SOD (kg/day)	CBODu (kg/day)	Organic N (kd/day)	Ammonia (kg/day)	
WLA for LA0104264	NA	34.97	16.46	32.92	84.36
WLA for LA0101834	NA	44.51	20.95	41.90	107.36
WLA for LA0108081	NA	7.95	3.74	7.48	19.17
WLA for LA0055051	NA	23.85	11.22	22.45	57.52
WLA for minor point sources	NA	81.00	569.66	284.83	935.49
MOS for all point sources	NA	48.07	155.51	97.40	300.98
LA for nonpoint sources	1,963.34	577.01	93.57	3.62	2,637.54
MOS for nonpoint sources	218.15	64.11	10.40	0.40	293.06
Total Maximum Daily Load	2,181,.49	881.47	881.51	491.00	4,435.48

The oxygen demand from organic nitrogen and ammonia nitrogen was calculated as 4.33 times the nitrogen loads (assuming that all organic nitrogen is eventually converted to ammonia). The value of 4.33 is the same ratio of oxygen demand to nitrogen that is used by the LA-QUAL model. For the SOD loads, a temperature correction factor was included in the calculations (in order to be consistent with LDEQ procedures).

5.2 Nutrient TMDL

As discussed in Section 2.2, Louisiana has no numeric standards for nutrients, but has a narrative standard that states that "the naturally occurring range of nitrogen-phosphorus ratios shall be maintained" (LDEQ 2000). For these TMDLs, nutrients were defined as total nitrogen (TKN plus nitrate/nitrite nitrogen) and total phosphorus. The value used for the naturally occurring nitrogen to phosphorus ratio was 8.0. This ratio was based on LDEQ reference stream data for the Upper Mississippi Alluvial Plain and South Central Plain ecoregions (Smythe 1999). These data are shown in Appendix T.

The first step in calculating the nutrient TMDL was to determine the loads of total nitrogen (TKN and nitrate-nitrite) that were simulated in the projection model. The loads in the projection model represent the maximum allowable loads that will maintain DO standards. Then the allowable loads of total phosphorus (TP) were calculated by dividing the nitrogen loads by the naturally occurring ratio of TN to TP (which was 8.0 as discussed above). The resulting loads of TN and TP for the Bayou Lafourche subsegment are presented in Table 5.2.

Table 5.2. Nutrient TMDL for Subsegment 080904 (Bayou Lafourche).

	Organic Nitrogen	Ammonia N	$NO_2 + NO_3$ N	Total N	Total P
WLA for LA0104264	3.80	7.60	15.21	26.61	3.33
WLA for LA0101834	4.84	9.68	19.35	33.87	4.23
WLA for LA0108081	0.86	1.73	3.46	6.05	0.76
WLA for LA0055051	2.59	5.18	10.37	18.14	2.27
WLA for minor point sources	131.56	65.78	30.32	227.66	28.46
MOS for all point sources	35.91	22.49	19.68	78.08	9.76
LA for nonpoint sources	21.61	0.84	0.94	23.38	2.92
MOS for nonpoint sources	2.40	0.09	0.10	2.60	0.32
Total Maximum Daily Load	203.57	113.39	99.43	416.39	52.05

5.3 Ammonia Toxicity Calculations

Although subsegment 080904 is not on a 303(d) List for ammonia, the ammonia concentrations predicted by the projection model were checked to make sure that they did not exceed EPA criteria for ammonia toxicity (EPA 1999). The EPA criteria are dependent on temperature and pH. The water temperature used to calculate the ammonia toxicity criterion for Bayou Lafourche was the same as the critical temperature used in the projection simulation (29.7°C). For pH, an average of the values measured at LDEQ stations 0071 and 0124 during the calibration period was used. The resulting criterion was 2.2 mg/L of ammonia nitrogen. Some of the instream ammonia nitrogen concentrations predicted by the LA-QUAL model for reaches 5 and 6 (Petticoat Bayou) were above the criterion. This indicates that ammonia nitrogen loadings that will maintain the DO standard in Petticoat Bayou may exceed the EPA ammonia toxicity criteria. The instream ammonia nitrogen concentrations predicted by the LA-QUAL model for the remainder of the system were well below the criterion. This indicates that the ammonia nitrogen loadings that will maintain the DO standard are low enough that the EPA ammonia toxicity criteria will not be exceeded under critical conditions. The ammonia toxicity calculations are shown in Appendix U.

5.4 Summary of NPS Reductions

In summary, the projection modeling used to develop the TMDLs above showed that NPS loads needed to be reduced by 81% and point source limits needed to be changed to maintain the DO standard in the lower Bayou Lafourche.

5.5 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the model accounts for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.6 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur in July through August, the lowest stream flows occur in October through November. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS, which is not quantified. In addition to the implicit MOS, the TMDL in this report includes explicit MOS of 10% for NPS loads and 20% for point source loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. Therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The calibration simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 6.1. Each parameter was varied by "30%, except for temperature, which were varied "2ºC.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration, depth, and SOD (benthal demand) were the parameters to which DO was most sensitive.

Table 6.1. Summary of results of sensitivity analyses.

Input Parameter	Parameter Change	Predicted minimum DO (mg/L)	Percent Change in Predicted DO (%)
Baseline	-	3.59	N/A
Reaeration	-30%	1.95	45.6
SOD	+30%	2.46	31.4
Velocity	-30%	2.56	28.6
Reaeration	+30%	4.54	26.6
Depth	+30%	2.73	23.9
Depth	-30%	4.40	22.5
Headwater flow	-30%	2.95	17.7
Initial temperature	+2EC	2.96	17.5
Initial temperature	-2EC	4.20	17.0
SOD	-30%	4.14	15.5
Headwater flow	+30%	3.92	9.1
Velocity	+30%	3.69	2.7
Wasteload flow	-30%	3.50	2.5
Wasteload flow	+30%	3.67	2.3
BOD decay rate	-30%	3.65	1.7
BOD decay rate	+30%	3.54	1.4
NH3 decay rate	-30%	3.59	<1
Organic N decay rate	+30%	3.59	<1
Organic N decay rate	-30%	3.59	<1
Wasteload BOD	+30%	3.58	<1
Wasteload BOD	-30%	3.60	<1
Wasteload NH3	+30%	3.59	<1
Wasteload NH3	-30%	3.59	<1
NH3 decay rate	+30%	3.59	0
Wasteload DO	+30%	3.59	0
Wasteload DO	-30%	3.59	0
Wasteload Organic N	+30%	3.59	0
Wasteload Organic N	-30%	3.59	0

7.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ NPS program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) List. The sampling schedule for the first five-year cycle is shown below. The Ouachita River Basin will be sampled again in 2004.

1998 – Mermentau and Vermilion-Teche River Basins
1999 – Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors.

8.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999 Court Order, this TMDL was prepared under contract to EPA. After development of the draft of this TMDL, EPA commenced preparation of a notice seeking comments, information, and data from the general and affected public. Comments and additional information were submitted during the public comment period and this TMDL was revised accordingly. Responses to these comments and additional information are included in Appendix V. EPA has transmitted this revised TMDL to LDEQ for incorporation into LDEQ's current water quality management plan.

9.0 REFERENCES

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APPENDIX A THROUGH T ARE AVAILABLE THROUGH EPA UPON REQUEST

APPENDIX U

Responses to Comments

COMMENTS AND RESPONSES
BAYOU LAFOURCHE TMDLs FOR DO AND NUTRIENTS
May 28, 2002

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses or notes inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ):

Note: LDEQ submitted one document containing comments on 98 TMDLs for various pollutants and subsegments throughout the Ouachita and Calcasieu basins. Only the portions of that comment document that apply to the DO and nutrient TMDLs in the Ouachita basin (10 subsegments) are shown below. Some of the general comments may not apply to this report.

The Louisiana Department of Environmental Quality hereby submits comments on the 98 TMDLs and the calculations for these TMDLs prepared by EPA Region 6 for waters listed in the Calcasieu and Ouachita river basins, under section 303(d) of the Clean Water Act. Listed below are general comments.

1. Many of these TMDLs are based on models using historical water quality data gathered at a single or small number of locations rather than survey data gathered at sites spaced throughout the waterbody. The hydraulic information used was generally an average value or estimated value, not taken at the same time as the water quality data. The calibrations are inadequate due to the lack of appropriate hydrologic data and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. A rationale was provided for data use and assumptions and limitations were given. Although LDEQ typically collects more data for model calibration than what was available for calibration of most of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to low dissolved oxygen, nutrients, or ammonia. Many of these waters simply have inappropriate standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO and/or nutrients) for each subsegment in the EPA Modified Court Ordered 303(d) List. TMDLs must be established to meet existing water quality standards. If it is determined that a standards changes is appropriate, the TMDL can be revised to reflect that change.

3. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. The TMDL report uses the LDEQ's multi-basin loading database's median ratio values between the ultimate loads and the proposed surrogates. This data was based on the measured data from the last two years of LDEQ water quality surveys. LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these parameters within the same waterbody, however when this correlation was attempted across waterbodies, extreme variability was seen and the correlations were not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from each modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, none of these subsegments had sufficient data from which these relationships could be developed. Relationships with surrogate parameters were used only when data for the desired parameter was not available.

4. BOD decay rates were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. The TMDL report uses the LDEQ's multi-basin loading database's median values. This data was based on the measured data from the last two years of LDEQ water quality surveys. It has been LDEQ's experience that these rates vary significantly from waterbody to waterbody and frequently vary significantly within the same waterbody. LDEQ objects to using surrogate data without regard for specific waterbody conditions for these parameters.

Response: Due to the schedule and level of resources available for this project, it was not feasible to perform long term BOD time series analyses on samples from these waterbodies. Given this situation, using LDEQ’s database was considered the best approach for estimating decay rates.

5. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for these subsegments. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. The available information for point source discharges indicated that the facilities discharging to these waterbodies do not have seasonal permit limits. If any of these facilities wishes to pursue seasonal permit limits, then LDEQ or the permittee can re-run the model to develop seasonal wasteload allocations.

6. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: These nutrient TMDLs were developed using naturally occurring ratios of nitrogen to phosphorus based on Louisiana's narrative water quality standard for nutrients. These ratios were calculated using reference stream data rather than long term monitoring data for each subsegment because the reference stream data were considered to be more appropriate for naturally occurring conditions.

7. LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in these TMDLs. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site- specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia toxicity calculations were performed to ensure that the ammonia loadings that will maintain DO standards will not cause any exceedences of the ammonia toxicity criteria. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia. EPA believes that this evaluation offers assurances that waters will continue to be free from the effects of toxic substances.

8. Algae were not simulated. Was there evidence that algae did not have an impact on the waterbody? Did the contractor have any Chlorophyll a measurements on which to base this determination?

Response: For most of these subsegments, the effects of algae were not simulated in the models because there were no data to clearly demonstrate a need for including algae and the models calibrated well without including algae (i.e., the models were calibrated without having to use unreasonable coefficients to compensate for algal effects).

SPECIFIC COMMENTS FROM LDEQ FOR BAYOU LAFOURCHE:

1. Based upon an 81% reduction in loads, these results suggest that a dissolved oxygen standard criteria change should be investigated. This was not noted in the report.

Response: The appropriateness of the DO standard was not mentioned in the report because the scope of this report was only the development of necessary TMDLs. Evaluation of the DO standard can be performed by LDEQ and documented in a separate report.

2. The margin of safety for both point sources and non-point sources should be 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLs were for oxygen demanding substances. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that was acceptable. However, EPA will consider this in future development of TMDLs in Louisiana.

COMMENTS FROM INTERNATIONAL PAPER COMPANY:

International Paper respectfully submits the following comments:

1. USEPA's modeling of the impact of organic **enrichment (CBODu) and nutrients is** made extremely difficult by the lack of adequate data for hydrologic and water quality characteristics. Proper calibration of the model is not possible. The level of uncertainty associated with the TMDL calculation is somewhat addressed in the sensitivity analysis. *However, the sensitivity analysis results are not even interpreted or discussed!* Furthermore, there is no discussion of whether the assumed values for many key parameters (e.g. SOD, kinetic coefficients) are reasonable, given the results of more detailed model calibrations for other similar watersheds. Given the obvious limitations of this modeling application, the resulting TMDLs should be clearly qualified as **provisional.**

Response: As discussed in the response to LDEQ's General Comment No. 1 above, these TMDLs were based on the most appropriate water quality and hydraulics data that could be obtained with available resources. In general, the coefficients in this model were consistent with and similar to values used in more detailed model calibrations in surrounding areas.

Although it would be ideal to have more data for developing these TMDLs, the amount of data that was available and the level of detail of the modeling were considered acceptable for developing TMDLs for this subsegment.

2. USEPA should include a section specifically providing for prompt review and revision of the TMDL by USEPA upon obtaining new information and updating of the modeling effort. Such information and model update could be generated either by USEPA itself, LDEQ, or other interested parties.

Response: EPA agrees that a TMDL can be revised if additional information is obtained that indicates that a revision is warranted. The process for revising a draft TMDL is discussed in Section 8 of the report. Assessing and revising an existing TMDL is discussed in Chapter 3 of EPA's 1991 document titled "Guidance for Water Quality-Based Decisions: The TMDL Process" (Chapter 3 can be obtained at www.epa.gov/OWOW/tmdl/decisions/dec3.html).

3. Finally USEPA should acknowledge that future ambient water quality information could result in delisting of the segment and rescinding of the TMDL.

Response: Currently, a waterbody/pollutant pair can be delisted when the TMDL is approved. TMDLs simply implement the appropriate water quality standard and the Clean Water Act encourages TMDL development for all waters. Therefore, TMDLs are not typically rescinded, once they are established for a waterbody, even when the waterbody is delisted.